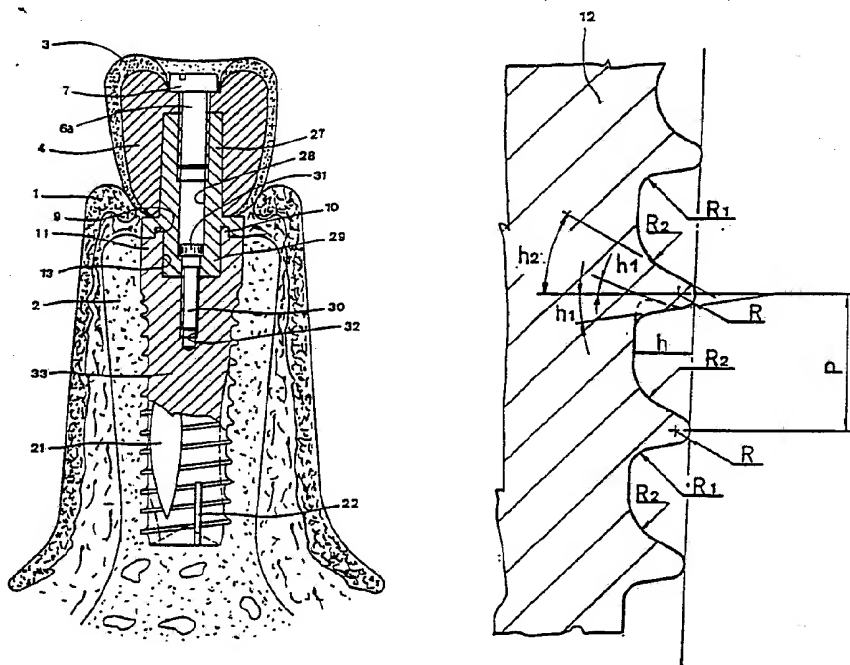


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b>  <b>A61C 8/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 93/06786</b>  <b>(43) International Publication Date:</b> 15 April 1993 (15.04.93)
<b>(21) International Application Number:</b> PCT/EP92/02301 <b>(22) International Filing Date:</b> 5 October 1992 (05.10.92)  <b>(30) Priority data:</b> MO91A000150      8 October 1991 (08.10.91)      IT  <b>(71)(72) Applicants and Inventors:</b> RUSSO, Gianni [IT/IT]; Via A. Sciesa, 10, I-37122 Verona (IT). FULGERI, Ugo [IT/IT]; Via Toscanini, 295, I-41100 Modena (IT).  <b>(74) Agent:</b> GARDI, Giuliano; Gardipatent, Via Giardini, 605 - Palazzo Prora, I-41100 Modena (IT).		<b>(81) Designated States:</b> JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE).  <b>Published</b> <i>With international search report.          Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** SCREW TYPE ENDOSTEAL DENTAL IMPLANT**(57) Abstract**

The endosteal dental implant, designed to bring about a drastic reduction in the interim period between insertion of the screw into the jaw bone and anchorage of the prosthesis (3, 4, 5), consists in an asymmetrical frustoconical screw (12) of which the leading thread flank is the steeper in relation to a line normal to the axis so that pressure is less under masticatory load: the body of the screw affords peripheral grooves or recesses (21) of lenticular outline, long though shallow, of which the maximum overall width is some 50 % of the circumference of the screw.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	MR	Mauritania
AU	Australia	GA	Gabon	MW	Malawi
BB	Barbados	GB	United Kingdom	NL	Netherlands
BE	Belgium	GN	Guinea	NO	Norway
BF	Burkina Faso	GR	Greece	NZ	New Zealand
BG	Bulgaria	HU	Hungary	PL	Poland
BJ	Benin	IE	Ireland	PT	Portugal
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	LI	Liechtenstein	SK	Slovak Republic
CI	Côte d'Ivoire	LK	Sri Lanka	SN	Senegal
CM	Cameroon	LU	Luxembourg	SU	Soviet Union
CS	Czechoslovakia	MC	Monaco	TD	Chad
CZ	Czech Republic	MG	Madagascar	TG	Togo
DE	Germany	ML	Mali	UA	Ukraine
DK	Denmark	MN	Mongolia	US	United States of America
ES	Spain			VN	Viet Nam
FI	Finland				

- 1 -

### Screw type endosteal dental implant.

The invention relates to a screw type endosteal dental implant, that is, an artificial dental element consisting in a metal insert screwed into a jaw bone, to which a prosthesis is anchored.

The prior art embraces implants in which the prosthesis is anchored to a screw below driven into the jaw bone, the screw coupling between the metal insert and the jaw bone being prepared through the agency of a thread cutting tool utilizing a key fitted to a shank of internal or external hexagonal profile afforded by the topmost part of the tool; the screw of the implant in any event affording a conventional thread of symmetrical profile; traditional screw implants being provided at the bottom end of the screw with tight, deep slots into which new bone can grow. Such implants required a long interim period between the step of insertion in the jaw bone and that of fitting the prosthesis, for example as long as 6 - 8 months, so as to allow new bone to grow into and fill the slots, thereby stabilizing the implant prior to the application of the prosthesis in view of the notable stresses transmitted to the implant during mastication, in order to avoid its collapse.

In addition, if new bone grows irregularly into the spaces existing between the adjacent crests of the screw thread the implant may be pushed toward the outside and destabilized.

Furthermore, the stresses transmitted to the implant during mastication give rise to components of stress acting on the jaw bone in a direction perpendicular to the axis of the implant, which may damage the bone and compromise the stability of the implant.

There are also implants having a cylindrical insert coated with hydroxyapatites which favour the growth of new bone, although implants of this type afford a very little degree

- 2 -

of retention.

The prior art stands in need of further improvement with regard to the possibility of bringing about a drastic reduction in the interim period, down to 2 or 3 months or even less, avoiding destabilization of the implant during said interim period because of asymmetrical growth of the jaw bone and greatly reducing or even eliminating any stress in a direction perpendicular to the axis of the implant, transmitted to the jaw bone during mastication. From the foregoing, the need will be discerned for a solution to the problem of providing an endosteal dental implant of which the screw thread affords a profile capable of self-tapping insertion into the jaw bone and stabilizing in a short time, said profile being able to prevent the new bone growing between adjacent crests of the profile from pushing the implant toward the outside and to greatly reduce or even eliminate any stress on the jaw bone in a direction perpendicular to the axis of the implant, during mastication.

The aforementioned problem is overcome according to the invention through the adoption of an endosteal implant that consists in a preferably frustoconical screw with a thread of asymmetrical profile: advantageously, the screw presents grooves or recesses of lenticular outline with a longitudinally disposed greater axis, distributed peripherally along the intermediate part of the body of the screw and having a depth of modest value gradually increasing from the outline inwards: the maximum aggregate width of the lenticular grooves or recesses being limited to 50% of the circumference of the thread or thereabouts; terminal grooves or recesses preferably being associated and intercalated with the grooves or recesses of lenticular outline, also of gradually increasing and modest depth.

The advantages obtained with the invention are: broader seating of the thread under the thrust of the masticatory

- 3 -

load and therefore reduced pressure on the jaw bone; reduction or even elimination of the stresses on the jaw bone in a direction perpendicular to the axis of the implant; a considerably shorter interim period; a complete self-tapping action with less removal of bone tissue, and with less pressure on the walls; a consequently lesser degree of bone lesion; a swifter arrival in the growth of new bone at the inner surface of the slot and distribution of the new growth over a greater surface spread over a circumference of greater diameter; the absence of any thrust toward the outside exerted by the new bone on the implant during its growth.

A number of possible embodiments of the invention are illustrated by way of example in the seven accompanying sheets of drawings, in which: fig 1 is a vertical cross section through a gum with the endosteal implant according to the invention inserted; fig 2 is a section as in fig 1 also showing a section of the prosthetic part of the implant; fig 3 is a section limited to the top part of the gum and the implant, illustrating the intermediate step of protection prior to suture; fig 4 is the horizontal section through IV-IV in fig 3; figs 5, 6 and 7 are the respective horizontal sections through V-V, VI-VI, VII-VII, illustrating the implant only; fig 8 is a partial and enlarged section of one side of the implant, illustrating the thread profile; fig 9 is a section as in fig 1, showing an embodiment particularly suitable for incisors and canines, i.e. of reduced thickness; fig 10 is a partial section similar to those of figs 1 and 2, illustrating an alternative method of fixing the prosthetic post.

In the drawings, 1 denotes the gum enveloping the alveolar bone 2 of the jaw; 3 denotes the crown covering a tooth 4 fitted over a post 5 tapered gently toward the top and affording a blind threaded axial hole 6 uppermost, which is fixed to the tooth by way of a screw 6a driven into the

- 4 -

tapped hole 6; 7 denotes the head of the screw. The post exhibits a hollow cylindrical base 8 affording a socket 9 at bottom positively engaging a collar 10 of reduced diameter extending from the topmost cylindrical portion 11 of the frustoconical screw 12 of the implant. 13 denotes a socket of prismatic profile, advantageously hexagonal, destined to receive a matching prismatic shank 14 of the post 5 which is extended as a cylindrical element 15 insertable into an axial bore 16 afforded by the screw 12. 17 denotes a topmost cylindrical portion of the bore 16, which is threaded to accept a screw 18 (fig 3) with a countersunk head 19 insertable into the topmost portion 11 of the frustoconical screw 12 to the end of securing an annular cap 20 fitted to the collar 10 for the duration of the interim period allowed for stabilization of the screw 12.

G denotes the topmost part of the gum 1 when newly grown or healed. 21 denotes one of a plurality of grooves or recesses, advantageously three in number, exhibiting a lenticular outline, distributed over the external surface of the frustoconical screw 12 and breaking up the relative thread, serving to accommodate the growth of bone trabeculae and prevent movement of the screw thereafter; 22 denotes one of a plurality of grooves or recesses with parallel flanks formed in the endmost portion of the screw 12 and serving to prevent its rotation. A denotes the diameter of the topmost cylindrical portion of the frustoconical screw 12, which is between 3,2 mm and 6 mm approx; B the mean diameter of the post 5, between 2,7 mm and 4,7 mm approx; C the diameter of the bottom end of the screw, between 3 mm and 5,8 mm approx; and D the diameter of the internal cylindrical element 15, between 1,5 mm and 1,9 mm approx.

CH2 denotes a convenient size of hexagonal key for insertion into the wrench socket 13 of the frustoconical screw 12, advantageously 2 mm.

- 5 -

H denotes the overall length of the insert comprising the frustoconical screw 12 of length H1, together with the relative topmost cylindrical portion 11 of length H2 and the collar 10 of length H3, for which the following ranges of values are envisaged:

$H = 8,4 - 20,7 \text{ mm}$

$H1 = 5,5 - 17,5 \text{ mm}$

$H2 = 2,5 \text{ mm}$

$H3 = 0,3 - 0,6 \text{ mm}$

M is the overall length of the post 5, approx 8 mm, which comprises the cylindrical base of length M1, approx 1 mm, and the topmost tapered portion of length M2, approx 7 mm; M5 denotes the length of the prismatic shank 14, approx 2,5 mm, and M6 the length of the cylindrical element 15, between 5 and 10 mm approx.

L is the length of the lenticular grooves or recesses 21, between 5 and 14 mm approx, which are 0,5 to 1 mm in depth and of maximum width such that the sum of their widths is no greater than 50% of the thread circumference or thereabouts; L1 denotes the length of the endmost grooves or recesses 22, between 3 and 5 mm approx, which are 1 mm approx in width and of maximum depth 0,6 mm approx.

P (fig 8) is the pitch of the thread afforded by the asymmetrical frustoconical self-tapping screw 12, advantageously 1 mm.

h is the depth of the thread, 0,4 mm approx; h1 the angle of the leading flank of the thread, which is the steeper in relation to the axis, advantageously up to  $5^\circ$  with respect to a line perpendicular to the axis, the gap being wider than the thread wall; h2 is the angle of the shallower flank, advantageously  $30^\circ$  approx with respect to a line perpendicular to the axis; the angle between the flanks of the thread being  $h1 + h2$  or  $h2 - h1$  (this embodiment being shown by dashed line in Fig. 8).

R is the crest radius, 0,1 mm approx; R1 the radius at the root of the steeper flank, 0,3 mm approx; and R2 the

- 6 -

radius at the root of the shallower flank, 0,7 mm approx. 23 (fig 9) denotes a thinner tooth fitted to a post 24 of suitable shape, and 25 and 26 an angled screw and the relative head, by means of which the tooth 23 is secured to the post 24.

27 (fig 10) denotes a post affording a through hole 28 with a bottom terminating portion 29 of reduced diameter and a prismatic external profile, through which to insert a fixing screw 30 with a hexagonal socket head 31 screwed down into the axial bore 32 of a frustoconical screw 33 similar to the screw 12 described above.

The distance between the steeper leading flank and the shallower flank of the adjacent thread (i.e. the thread space) being greater than the thread thickness, measured on a line parallel to the axis and at a distance therefrom corresponding to the mean radius of the average radius.

The thread space being wide enough to allow a regular growth of the new bone and to define a considerable stress-resistant section for the new bone.

In practical application, the materials, dimensions and details of execution might be different to those described and illustrated while equivalent in terms of the art, without straying from within the bounds of protection afforded to the invention.

Accordingly, in particular, the dimensions and the proportions indicated might be varied in particular instances, albeit in moderation.



- 7 -

## CLAIMS

1. Screw type endosteal dental implant, comprising a screw insertable into the jaw bone, having a bottom end provided with grooves and a top end affording a fitting for the post of the prosthesis, characterized in that the screw is self-tapping, with an asymmetrical thread having a leading flank almost perpendicular to the axis of the screw.
2. Implant as in claim 1, wherein said leading flank is steeper than the other flank with respect to the axis of the screw (12).
3. Implant as in claim 2, wherein the distance between said steep leading flank and the shallower flank of the adjacent thread is greater than the thread thickness.
4. Implant as in claim 1, wherein the screw (12) is frustoconical.
5. Implant as in claim 1, wherein the body of the screw (12) affords grooves or recesses (21) of lenticular outline with the greater axis longitudinally disposed, peripherally distributed, having a depth increasing gradually from the outline inward to reach modest values; the maximum aggregate width of said grooves or recesses of lenticular outline being limited advantageously to within a value some 50% of the circumference of the thread.
6. Implant as in claim 1, wherein the body of the screw (12) affords a prismatic socket (13) uppermost to allow rotation by means of a key.
7. Implant as in claim 6, wherein the post (5) affords a hollow base (8) at bottom aligned and associated with a collar (10) afforded by the top end of the screw (12), and a prismatic shank (14) extending downward from the bottom of the base, positively coupled with the prismatic socket (13), said shank extending downward as a cylindrical element (15) of smaller diameter insertable into an axial bore (16) afforded by the screw; the tooth (4) being anchored to the post by means of a further screw (6a)

- 8 -

insertable into a threaded hole (6) afforded by the post.

8. Implant as in claim 6, wherein the post (5) affords a hollow base (8) at bottom aligned and associated with a collar (10) afforded by the top end of the screw (12), and a prismatic shank (29) extending downward from the bottom of the base, positively coupled with the prismatic socket (13); said post and said shank affording a through hole (28) with a bottom terminating portion (29) of reduced diameter through which to insert a screw (30), with a hexagonal socket head (31), screwed into an axial bore (32) beneath that extends from said prismatic socket into the body of the self-tapping asymmetrical frustoconical screw (12); the topmost portion of said through hole affording a thread into which to insert a screw (6a) by which the tooth (4) is anchored to the post (5).

9. Implant as in claims 1, 3, wherein said screw (12) has advantageously a pitch  $P = 1$  mm and exhibits the following parameters:

- h1, angle of steeper flank, in relation to a line perpendicular to the axis, up to  $5^\circ$  approx;
- h2, angle of shallower flank, in relation to a line perpendicular to the axis,  $30^\circ$  approx;
- h, depth of thread, 0,4 mm approx;
- R1, R2, radii of the two flanks at the root, respectively 0,3 mm and 0,7 mm approx;
- R, crest radius, 0,1 mm approx.

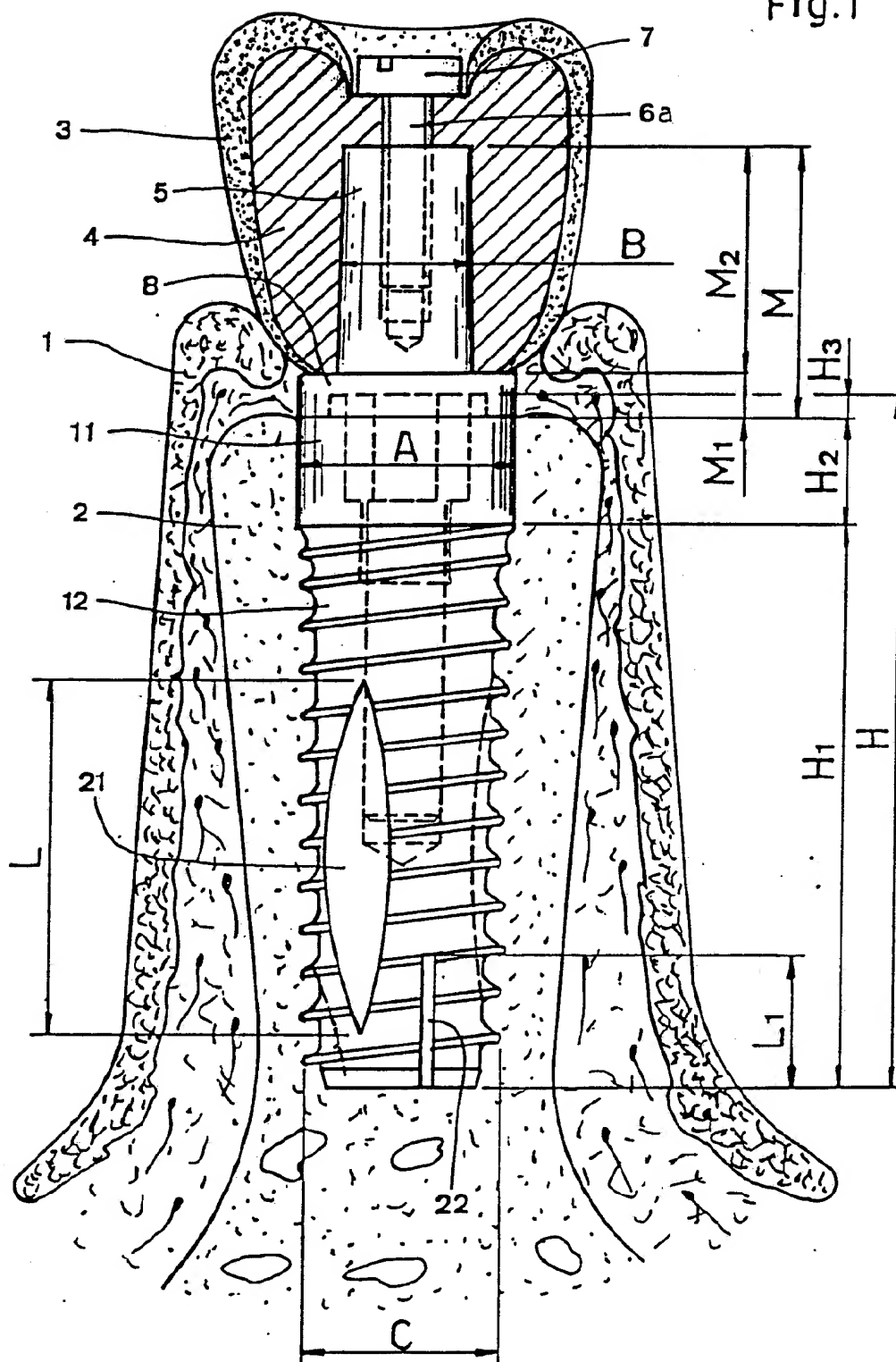
10. Implant as in claim 5, wherein said grooves or recesses (21) of lenticular outline (21) have a length (L) between 5 and 14 mm approx, and a maximum depth between 0,5 and 1,2 mm approx.

11. Implant as in claim 9, wherein the angle between said flanks is equal to the sum of the angle (h2) of the shallower flank and the angle (h1) of the steeper flank.

12. Implant as in claim 9, wherein the angle between said flanks is equal to the difference between the angle (h2) of the shallower flank and the angle (h1) of the steeper flank.

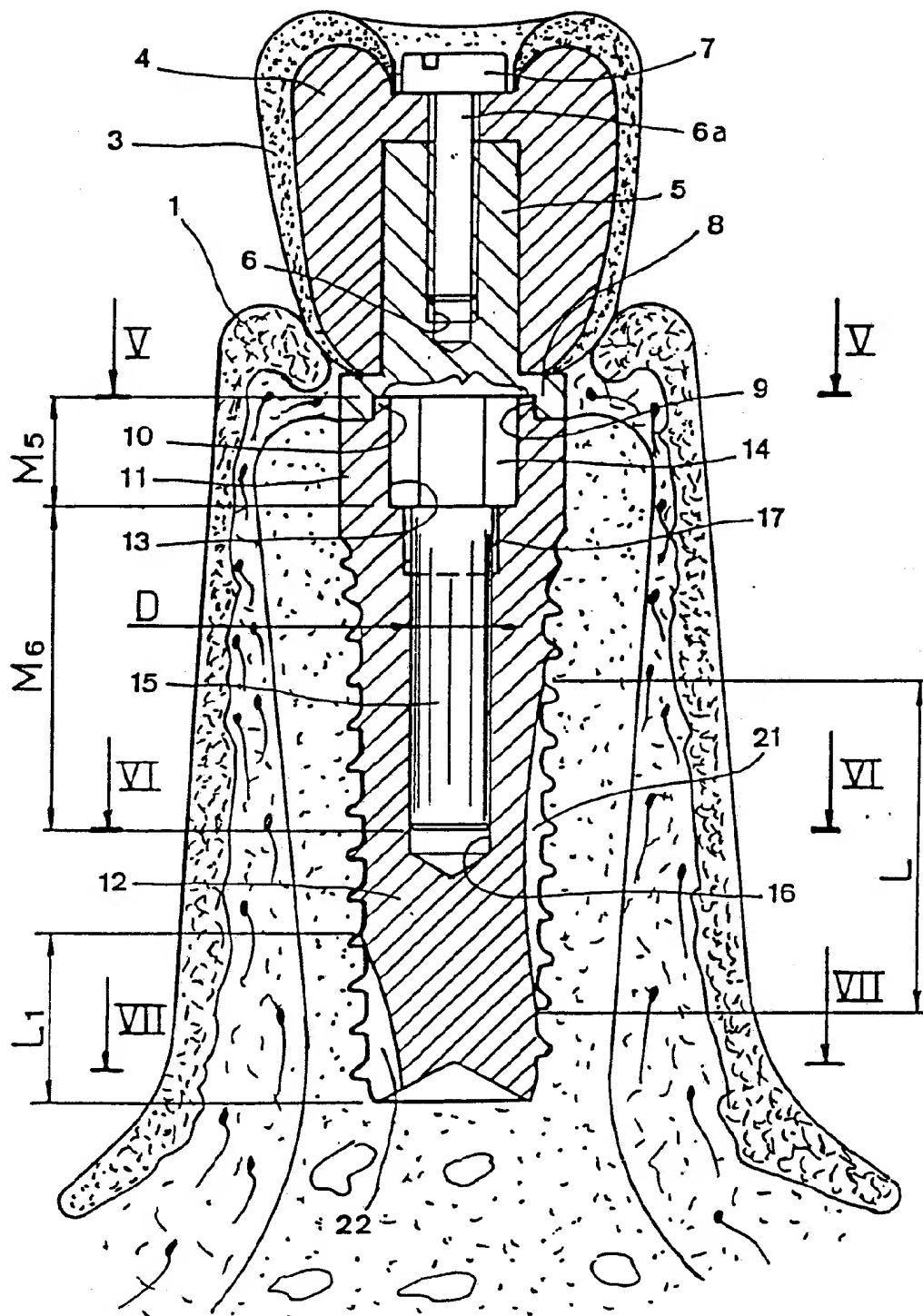
1/7

Fig.1



2/7

Fig. 2



3/7

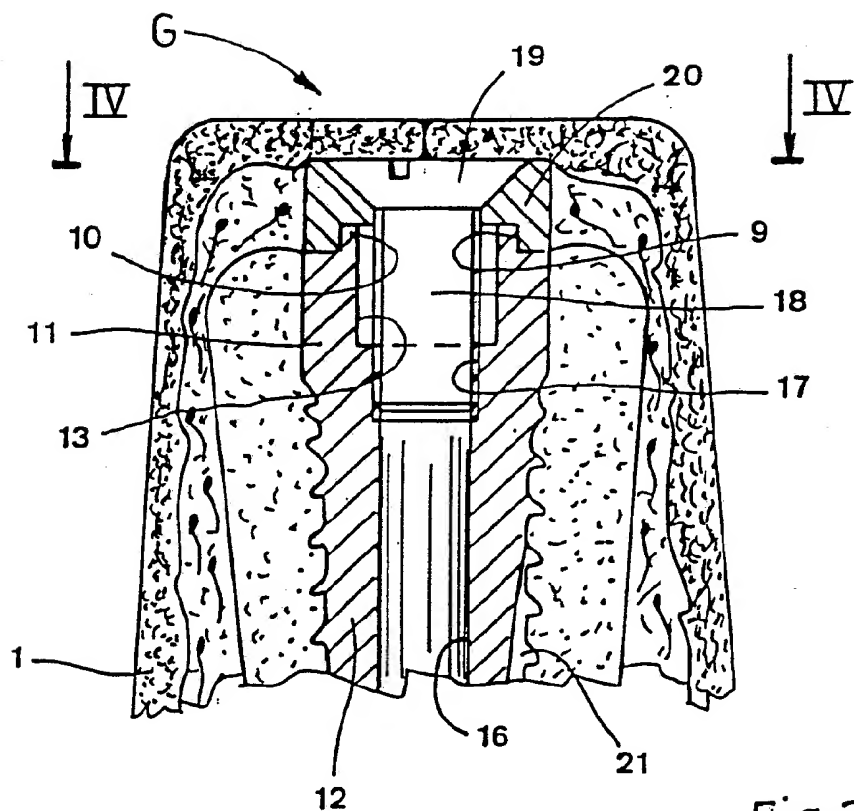
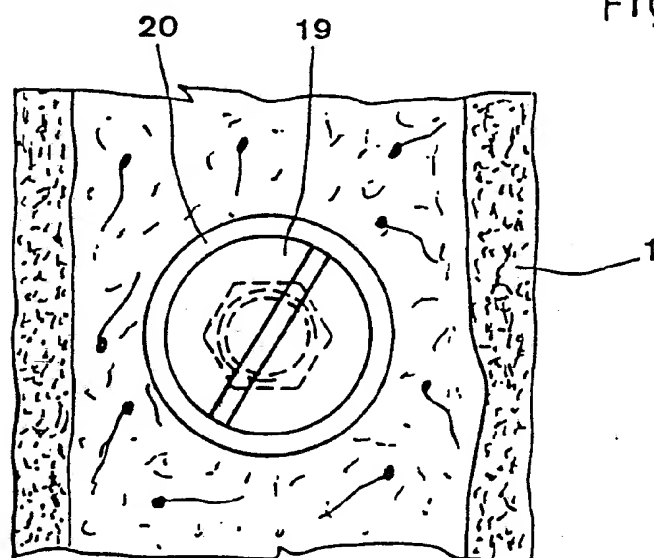


Fig.3

Fig.4



4/7

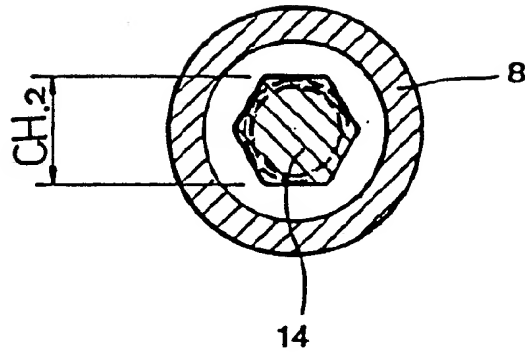


Fig.5

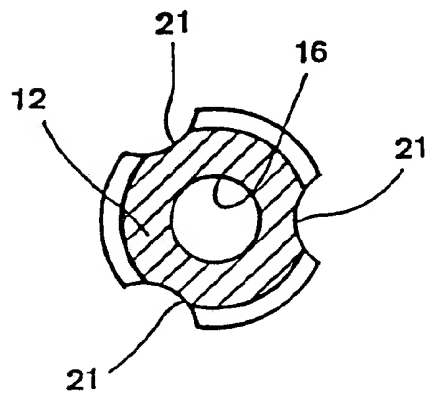


Fig.6

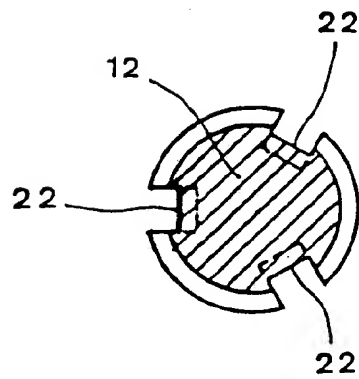
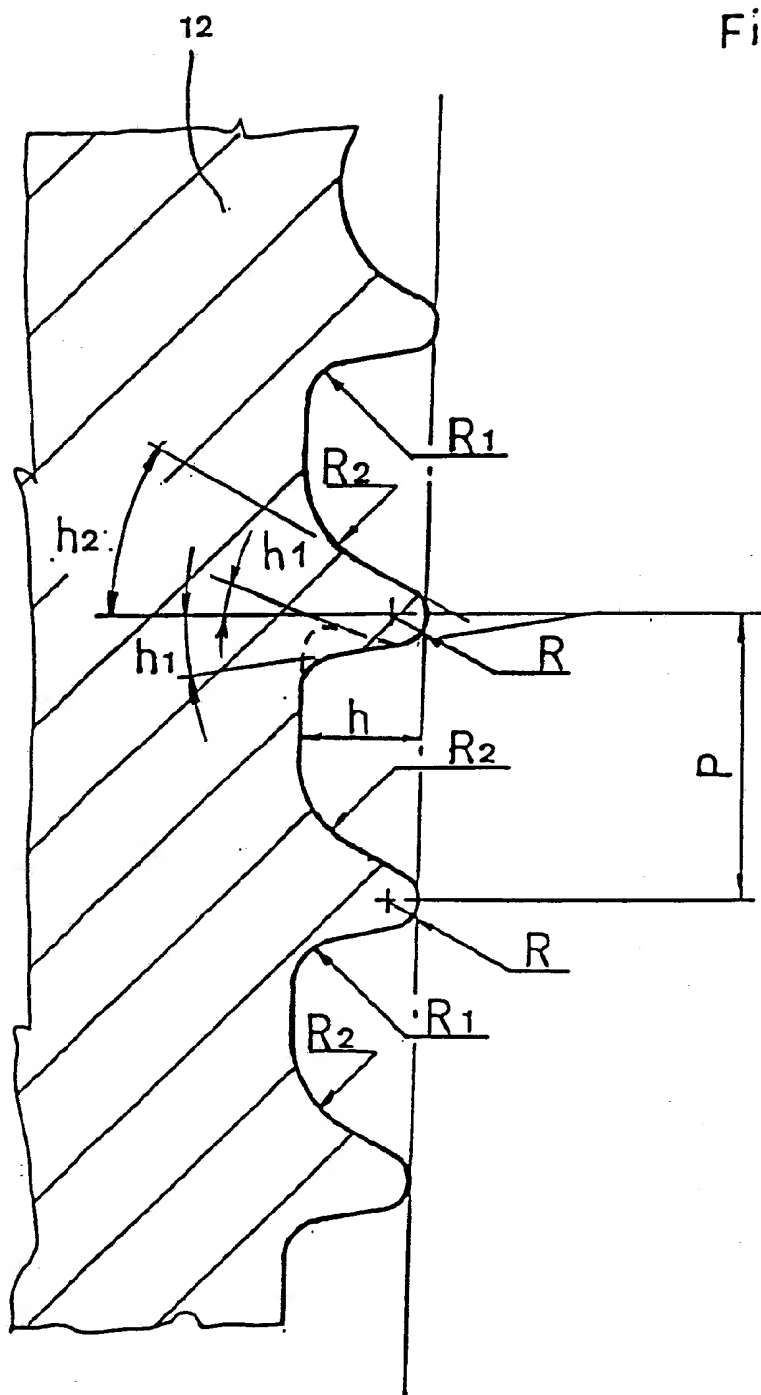


Fig.7

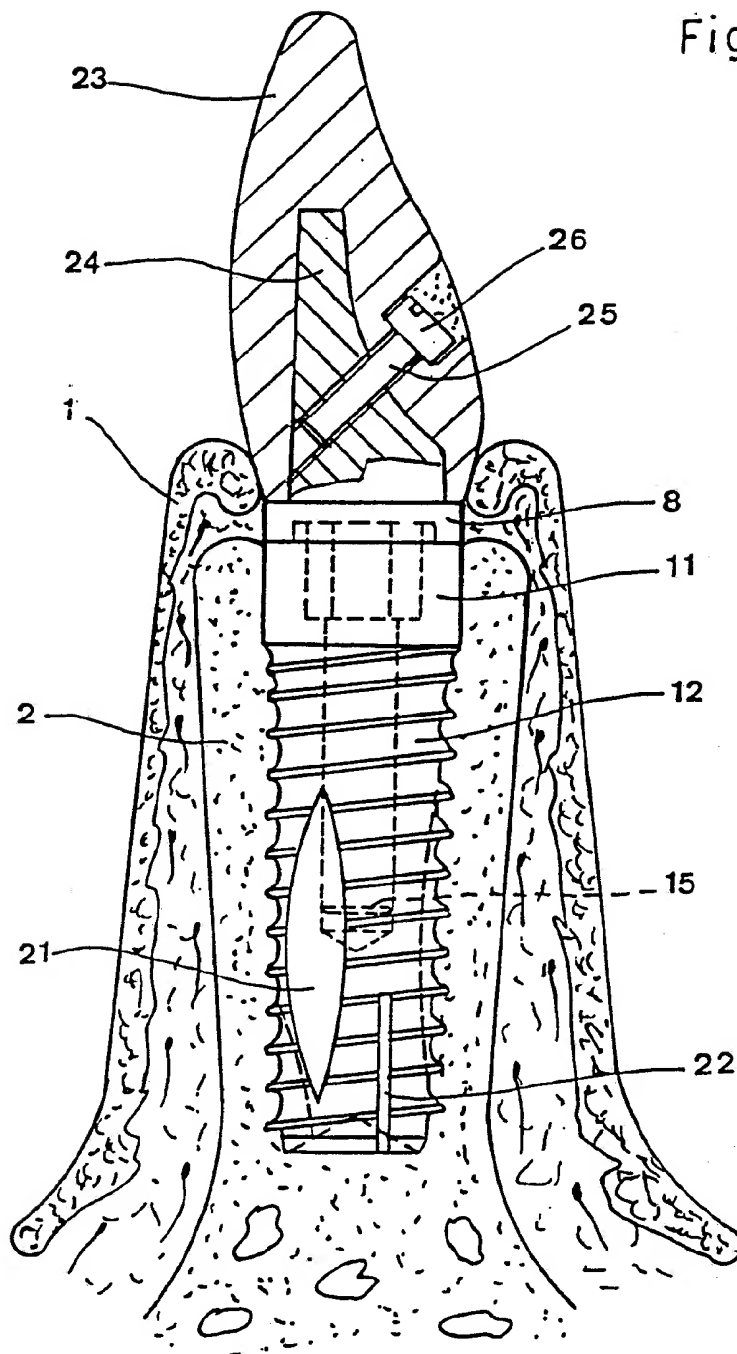
5/7

Fig.8



6/7

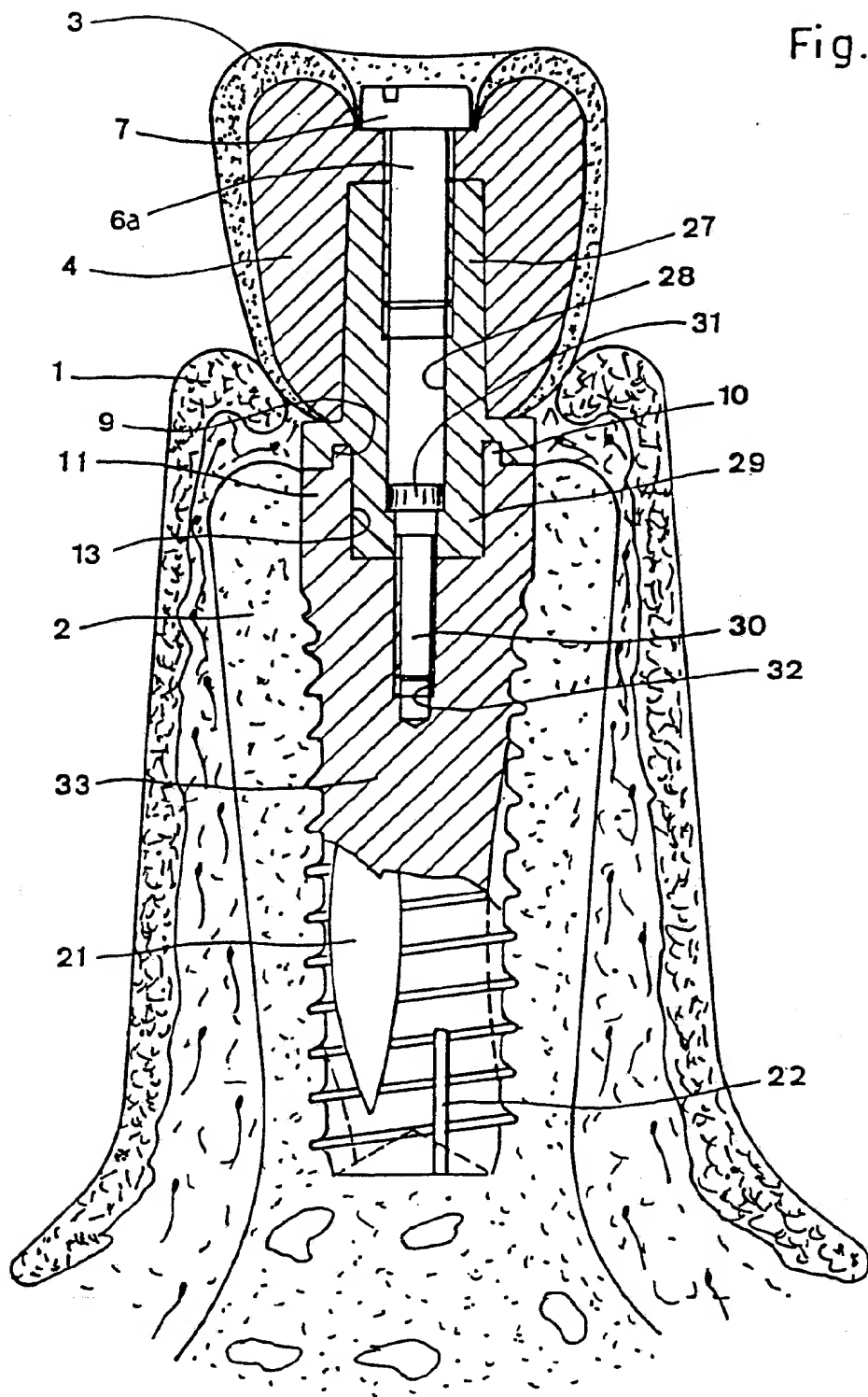
Fig.9





7/7

Fig.10



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 92/02301

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 A61C8/00		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	A61C ; A61F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	EP,A,0 282 789 (GRAFELMAN) 21 September 1988 see column 1, line 4 - line 8 see column 3, line 5 - line 7 see column 3, line 15 - line 26; figures 1,4 ---	1-4
X	EP,A,0 263 274 (VENT PLANT) 13 April 1988 see column 2, line 16 - line 21 see column 4, line 51 - column 5, line 32; figures 2-4,11 ---	1-3,6
A	---	5,7
A	US,A,4 846 683 (LAZZARA) 11 July 1989 see column 2, line 40 - line 52; figure 2 ---	7
	--- -/-	
<p><sup>10</sup> Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search 23 FEBRUARY 1993		Date of Mailing of this International Search Report 04. 03. 93
International Searching Authority EUROPEAN PATENT OFFICE		Signature of Authorized Officer PAPONE F.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category <sup>o</sup>	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	GB,A,2 199 626 (CORE-VENT CORP.) 13 July 1988 see abstract; figures 2,3 ---	6
A	MECHANISCHE VERBINDUNGSTECHNIK vol. 14, no. 1, 1990, DUSSELDORF DE page 16 , XP107511 -----	9

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.**

EP 9202301  
SA 66456

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 23/02/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0282789	21-09-88	DE-A- 3708638	29-09-88
		US-A- 4863383	05-09-89
EP-A-0263274	13-04-88	US-A- 4713004	15-12-87
		AU-A- 4854090	10-05-90
		AU-A- 4854190	10-05-90
		AU-A- 7794087	10-03-88
		AU-A- 8032191	03-10-91
		CA-A- 1298496	07-04-92
		DE-A- 3778817	11-06-92
		EP-A- 0449334	02-10-91
		JP-A- 63125251	28-05-88
		US-A- 4842518	27-06-89
		US-A- 4932868	12-06-90
US-A-4846683	11-07-89	None	
GB-A-2199626	13-07-88	DE-A- 3735378	21-07-88
		JP-A- 63174648	19-07-88
		US-A- 4960381	02-10-90